Soliton-Actuated Diaphragmic Debris Deflection System for Orbital Platform Protection

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Introduction

Expanding upon the conception of 1 May 2023, soliton-actuated copper plates may, in addition to being used to provide emergency structural support to architectural endoskeleton structures, in the event of, for example, downed trees, may be applied to satellite protection from small debris with some modifications.

Abstract

When deflecting smaller objects moving at higher velocities than falling tree branches such as those encountered in Low-Earth Orbit, it is necessary that any reactive system be able to provide a counterforce which is exquisitely calibrated in terms of both timing, kinetic force gradient over time and the area of actuation. Debris has a wide variety of shapes, sizes, densities, masses and even rotational characteristics which could complicate this conceptualized deflective technology.

At the essence of this concept is the idea of applying a precisely symmetric counterforce against a piece of debris striking a deflector plate made of copper. Copper must be used as this is one of the only materials which will react appropriately to soliton waves. If a copper plate or any other plate is struck by a piece of debris, for example, moving at a relative velocity of 5,000 MPH, it would punch a hole in the plate. If that plate were made, as in explosive-reactive armor, to move at 10,000 MPH in the opposite direction, the object in question would be deflected, but the plate would be destroyed.

However, if, upon the detection of an impact by an object moving at a particular velocity the plate were energetically actuated in a manner which is precisely symmetrical, the two forces would negate one-another and the plate would not be seriously damaged. This would, of course, depend upon the ability to precisely sense and promptly react to the impact.

Although orbital debris moves at a high velocity, electronic systems would be able to react in a sufficiently alacritous manner so as to ensure that such a deflector plate could be actuated with the appropriate amount of force to prevent damage to the deflector and to deflect the material safely away from the satellite which the deflector protects.

This system would require that soliton waves be generated of potentially extreme intensity over a short period of time, meaning that the system would require substantial available electrical energy and an ability to generate light of extreme intensity of up to 60 million lumens over a duration of 55-450 microseconds in order to support soliton waves of sufficient intensity to generate the needed counterforce. Fine control over the amount of force

applied and the ability to apply dramatically different amounts of force in closely collocated areas would be essential as the counterforce would need to be made to carefully conform to the force. If counterforce exceeds force in any area, it would permanently disable the deflector. The theoretical maximum granularity of such as system would be governed by the diameter of the glass nanospheres, which are necessarily matched to the phase height of the light used. For blue light, this would correspond to a phase height of ~11 nanometers, meaning that unique levels of counterforce could be applied to spherical zones each of which are 11 nanometers in diameter.

Provided such a capability, a satellite could be encased in a spherical shell which is thin enough so as to permit normal radio transmissions (with pinholes for optical transmissions) which is composed of a series of curved hexagonal pieces which fit together.

Conclusion

Once constructed, such deflector shields could bestow upon LEO satellites a "Kessler Syndrome-Ready" capability which allows the satellites to survive despite an extremely congested post-Kessler Event environment. Interestingly, such a deflective capability would be essential for ensuring the survival of spacecraft traveling at relativistic velocities through deep space which could be expected to routinely experience high-energy collisions with small objects the size of grains of sand routinely.